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# A Quench Detection and Monitoring System for Superconducting Magnets at Fermilab

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A quench detection system was developed for protecting and monitoring the superconducting solenoids for the Muon-to-Electron Conversion Experiment (Mu2e) at Fermilab. The quench system was designed for a high level of dependability and long-term continuous operation and is based on three tiers: Tier-I, FPGA-based Digital Quench Detection (DQD); Tier-II, Analog Quench Detection (AQD); and Tier-III, quench controls and data management system. The Tier-I and Tier-II are completely independent and fully redundant systems. The Tier-III system is based on National Instruments (NI) C-RIO and provides the user interface for quench controls and data management. It is independent from Tiers I & II. The DQD provides both quench detection and quench characterization (monitoring) capability. Both DQD and AQD have built-in high voltage isolation and user programmable gains and attenuations. The DQD and AQD also includes user configured current dependent thresholding and validation times.

A 1st article of the three-tier system was fully implemented on the new Fermilab magnet test stand for the HL-LHC Accelerator Upgrade Project (AUP). It successfully provided quench protection and monitoring for a cold superconducting bus test in November 2020 and later for the AUP magnets. A detailed description of the system along with results from the AUP superconducting bus test and the pre-series magnet tests will be presented.

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